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A COMPARATIVE ANALYSIS OF RUSSIAN INDUSTRIAL STRUCTURE

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Abstract

This paper undertakes a preliminary analysis of Russia's industrial structure by comparing the disaggregated output structures of Russia and the United States. Data is obtained from the Russian 111-sector bench-mark input-output table for 1987 and the U. S. 85-sector input-output tables for 1972 and 1977.

Comparion with the United States clarifies the industrial aspect of Russian military expenditures. The analysis also illustrates the relationship between the Russian industrial structure and defense policy, and uses conventional impact analysis to show similarities between Russia and the United States.

I. *Introduction*

It is widely recognized that the Russian economy experienced severe difficulties in the years 1991–94, largely due to declining demand from the defense sector and delay in the reform ("conversion") of the defense-oriented industrial structure. However, the Russian economic structure heavily relying on defense has not yet been fully analyzed, mainly owing to lack of reliable official data for national product accountings and input-output accountings, particularly at a disaggregated level.

This paper provides preliminary observations on the structure of the Russian economy by drawing on comparisons with the United States. The major sources of data are Russian input-put tables for 1987 and U. S. input-output tables for 1972 and 1977. As the U.S. input-output tables include a separate column of the federal government expenditures for defense, we are able to expect to get some basic information for clarifying the Russian case.

First, this paper makes a comparison of disaggregated output structures in Russia and the United States. Secondly, it clarifies an aspect of Russian military expenditures during the Gorbachev perestroika. Thirdly, this paper presents some results of impact analyses. Through these analyses this paper shows some characteristics of the Russian industrial structure relying on defense, and similarities between Russia and the United States.

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II. *Russian Disaggregated Industrial Structure: A Comparative View*

When making an input-output analysis, the greater the degree of disaggregation, the better able we are to make concrete analysis of the input-output structure of an economy. In particular, this is true for the Russian case, because very few analyses have been presented in terms of expenditures for defense in the framework of national accounts.

The most detailed and updated bench-mark input-output table for Russia is the 111-order version for 1987, compiled by Goskomstat RF. We employ this version in purchasers' prices to clarify the Russian input-output structure in comparison with that of the United States. In the case of the United States we employ the 85-order commodity-by-commodity table in producers' prices, compiled by merging the make and use tables of the BEA of the U.S. Department of Commerce (partially based on the author's calculation).

For both countries, very few studies have been conducted in terms of direct comparisons to date. Therefore, we employ the original sector codes and prices used in both countries.

TABLE 1. DISAGGREGATED RUSSIAN OUTPUT BY SECTOR, 1987

(In percentage)

Rank	Goskomstat 111-Order Code	Sector	GDO	Rank	Goskomstat 111-Order Code	Sector	GDO
1	101	Construction	10.40	27	93	Fish products	1.01
2	103	Livestock	7.71	28	71	Other construction materials	0.98
3	102	Crops	5.27	29	43	Tractors and agricultural M&E	0.98
4	105	Transportation	4.79	30	5	Coal	0.96
5	54	Other machine industry	3.95	31	67	Prefab concrete	0.96
6	41	Automobiles	2.74	32	32	Electric M&E	0.92
7	3	Oil refining	2.64	33	58	Logging	0.90
8	9	Iron & steel	2.59	34	95	Flour and cereals	0.83
9	53	Radio and electronics	2.56	35	56	Other metal wares	0.74
10	57	Repair of M&E	2.38	36	96	Processed animal feeds	0.72
11	1	Electric and thermal power	2.34	37	90	Other foods	0.68
12	107	Trade & restaurants	2.33	38	82	Bread and bakery products	0.68
13	91	Meat products	2.27	39	62	Paper and pulp	0.68
14	14	Nonferrous metals	2.25	40	77	Hosiery and knitwear	0.68
15	2	Crude oil	1.83	41	83	Confections	0.64
16	79	Sewn goods	1.79	42	111	Other material production	0.59
17	73	Cotton materials	1.73	43	87	Wine	0.59
18	86	Alcoholic beverages	1.61	44	61	Furniture	0.57
19	75	Wool materials	1.61	45	81	Sugar	0.53
20	4	Gas	1.37	46	34	Chemical equipment	0.53
21	80	Other light industry products	1.34	47	13	Nonferrous ores	0.49
22	92	Dairy products	1.33	48	76	Silk materials	0.48
23	59	Sawmills and lumber products	1.24	49	52	Ships	0.47
24	40	Precision instruments	1.21	50	84	Edible oils and fats	0.46
25	100	Other industry	1.19	51	24	Rubber products	0.44
26	16	Basic chemistry products	1.17	52	23	Organic synthetic products	0.43

Rank		Sector Goskomstat 111-Order Code	GDO	Rank		Sector Goskomstat 111-Order Code	GDO
53	25	Asbestos products	0.43	83	94	Bio-industry product	0.14
54	109	Technical supply	0.41	84	38	Tools and dies	0.14
55	44	Construction M&E	0.38	85	42	Bearings	0.14
56	78	Other textile products	0.37	86	10	Coke product	0.14
57	12	Industrial metal products	0.35	87	46	Light industry M&E	0.12
58	27	Energy and power M&E	0.33	88	29	Mining M&E	0.11
59	97	Chemicals	0.33	89	15	Mineral chemistry products	0.09
60	19	Plastic products	0.32	90	21	Aniline dye products	0.08
61	72	Glass and porcelain	0.31	91	47	Food industry M&E	0.07
62	18	Synthetic resins & plastics	0.31	92	104	Forestry	0.07
63	50	Household appliances	0.31	93	39	Abrasives	0.07
64	68	Wall materials and tile	0.30	94	65	Asbestos-cement and slate	0.07
65	85	Cosmetic products	0.29	95	36	Forging-pressing equipment	0.06
66	89	Tobacco	0.29	96	63	Wood chemistry products	0.06
67	20	Prints & lacquers	0.29	97	60	Plywood	0.06
68	35	Machine tools	0.29	98	110	Information processing	0.06
69	74	Flax materials	0.28	99	70	Polymer construction materials	0.06
70	55	Metal structure	0.28	100	98	Medical equipment	0.05
71	26	Other chemicals	0.26	101	11	Refractory materials	0.05
72	8	Ferrous ores	0.26	102	48	Trade M&E	0.05
73	17	Synthetic fibers	0.26	103	28	Metallurgical M&E	0.05
74	22	Synthetic rubber	0.26	104	66	Roofing materials	0.05
75	31	Railroad transportation M&E	0.23	105	69	Construction ceramics	0.05
76	64	Cement	0.23	106	45	Communal and daily service M&E	0.04
77	33	Cable products	0.21	107	7	Peat	0.03
78	108	Procurement	0.20	108	99	Medical supplies	0.02
79	88	Fruit & vegetable products	0.19	109	49	Printing M&E	0.01
80	30	Hoisting-transporting M&E	0.18	110	37	Casting equipment	0.01
81	106	Communications	0.17	111	6	Oil shales	0.00
82	51	Sanitary engineering	0.15			Gross domestic output, total	100.00

Source: Goskomstat RF, *The Russian Input-Output Table for 1987*, Moscow, 1989.

TABLE 2. DISAGGREGATED U.S. OUTPUT BY SECTOR, 1977

(In percentage)

Rank		Sector BEA's 85-Order Code	GDO	Rank		Sector BEA's 85-Order Code	GDO
1	69	Wholesale and retail trade	10.54	13	74	Eating and drinking places	2.40
2	71	Real estate and rental	7.62	14	12	Repair and mainte.construction	2.01
3	82	Government industry	5.57	15	37	Primary iron & steel manu.	1.74
4	14	Food and kindred products	5.26	16	27	Chemicals	1.73
5	11	New construction	5.20	17	2	Other agricultural products	1.72
6	77	Health, edu., and soc. services	4.42	18	66	Communications except rad/ TV	1.44
7	73	Business services	4.42	19	1	Livestock and livestock products	1.33
8	70	Finance and insurance	3.51	20	72	Hotels; personal and repair serv.	1.26
9	65	Transportation	3.50	21	8	Crude petroleum and natural gas	1.19
10	68	Private electric, gas, water	3.34	22	75	Automobile repair and services	1.18
11	59	Motor vehicles and equipment	3.19	23	18	Apparel	1.13
12	31	Petroleum refining	2.62	24	38	Primary nonferrous metals manu.	1.11

Rank		Sector BEA's 85-Order Code	GDO	Rank		Sector BEA's 85-Order Code	GDO
25	32	Rubber and plastics products	1.09	56	43	Engines and turbines	0.30
26	20	Lumber and wood products	1.05	57	54	Household appliances	0.28
27	24	Paper and allied products	1.03	58	22	Household furniture	0.28
28	26	Printing and publishing	0.87	59	19	Miscellaneous fabricated textile	0.25
29	29	Drugs, cleaning and toilet prep.	0.78	60	35	Glass and glass products	0.25
30	56	Radio, TV, and comm. equipment	0.77	61	17	Miscellaneous textile goods	0.25
31	42	Other fabricated metal products	0.77	62	4	Agricultural, forestry, and fishery	0.24
32	40	Heating, plumbing, and fabricated	0.74	63	13	Ordnance and accessories	0.24
33	16	Broad and narrow fabrics	0.72	64	48	Special industry machinery	0.24
34	36	Stone and clay products	0.70	65	58	Miscellaneous electrical M	0.24
35	60	Aircraft and parts	0.69	66	39	Metal containers	0.23
36	76	Amusements	0.67	67	50	Miscellaneous machinery	0.23
37	83	Rest of the world industry	0.64	68	55	Electric lighting and wiring E	0.22
38	28	Plastics and synthetic materials	0.61	69	23	Other furniture and fixtures	0.18
39	61	Other transportation equipment	0.58	70	30	Paints and allied products	0.17
40	41	Screw machine products	0.55	71	34	Footwear and other leather	0.17
41	64	Miscellaneous manufacturing	0.52	72	84	Household industry	0.16
42	53	Electric industrial equipment	0.50	73	3	Forestry and fishery products	0.14
43	45	Construction and mining machinery	0.46	74	46	Materials handling M&E	0.14
44	7	Coal mining	0.45	75	79	State and local govnt. enterprises	0.14
45	49	General industrial machinery E	0.45	76	9	Stone and clay mining	0.13
46	51	Office, computing & accounting M	0.43	77	6	Nonferrous metal ores mining	0.09
47	57	Electronic components	0.40	78	81	Scrap and used goods	0.06
48	78	Federal Government enterprises	0.39	79	5	Iron and ferroalloy ores mining	0.06
49	47	Metalworking M&E	0.38	80	33	Leather tanning and finishing	0.04
50	62	Scientific & controlling instrument	0.37	81	10	Chemical, fertilizer mineral mining	0.04
51	25	Paperboard containers and boxes	0.36	82	67	Radio and television broadcasting	0.01
52	15	Tobacco manufactures	0.35	83	21	Wood containers	0.01
53	63	Optical, ophthalmic, and photo E	0.32	84	80	Noncomparable imports	0.00
54	44	Farm and garden machinery	0.31	85	85	Inventory valuation adjustment	-0.51
55	52	Service industry machines	0.31			Gross domestic output, total	100.00

Source: Interindustry Divison, BEA, "The Input-Output Structure of the U.S. Economy," *Survey of Current Business*, May 1984.

Table 1 presents the disaggregated domestic output structure of Russia in 1987 at domestic and purchasers' prices, while Table 2 displays that of the United States in 1977 at producers' prices. Table 3 shows the structure of final demand for defense in Russia (1987) and the United States (1977). It should be noted that Table 3 for Russia in 1987 is obtained by making an assumption that the column named as "other expenditures" in the Russian input-output table reflects the main part of final demand for defense activities specified in the input-output table. The result for the United States would support this assumption.

As is shown by Tables 1 and 3, in Russia the "other machine industry" sector shows the highest share in both 'industrial' outputs and final demand for defense; 4% in the total gross domestic output and 68% in the total final demand for defense. The "radio and electronics" sector shows the second highest share in final demand for defense, 8%, followed by "ships", "basic chemical products", "oil refining" and "rubber products". The "radio and electronics" sector also shows rather high share in the total gross domestic output; 3%.

TABLE 3. STRUCTURE OF DEMAND FOR DEFENSE IN RUSSIA AND THE U.S.

Russia, 1987

Rank		Sector Goskomstat 111-Order Code	thousand rubles	%
1	54	Other machine industry	16,248,907	68.3
2	53	Radio and electronics	1,847,820	7.8
3	52	Ships	1,487,487	6.3
4	16	Basic chemistry products	1,365,043	5.7
5	3	Oil refining	855,220	3.6
6	24	Rubber products	427,702	1.8
7	25	Asbestos products	389,649	1.6
8	79	Sewn goods	356,885	1.5
9	41	Automobiles	336,600	1.4
10	31	Railroad transportation M	76,509	0.3
11	56	Other metal wares	61,121	0.3
12	43	Tractors and agricultural	59,574	0.3
13	74	Flax materials	58,063	0.2
14	57	Repair of M&E	49,000	0.2
15	86	Alcoholic beverages	48,841	0.2
16	75	Wool materials	47,579	0.2
17	32	Electric M&E	40,195	0.2
18	73	Cotton materials	26,168	0.1
19	9	Iron and steel	7,137	0.0
Total final demand for defense			23,789,500	100

U.S.A., 1977

Rank		Sector BEA's 85-Order Code	Mil.$	%
1	82	Government industry	42,213	45.5
2	60	Aircraft and parts	9,166	9.9
3	13	Ordnance and accessories	5,157	5.6
4	56	Radio, TV, and communication equipment	4,395	4.7
5	80	Noncomparable imports	3,406	3.7
6	61	Other transportation equipment	2,846	3.1
7	65	Transportation and warehousing	2,728	2.9
8	73	Business services	2,666	2.9
9	11	New construction	2,361	2.5
10	12	Repair and maintenance construction	2,265	2.4
11	31	Petroleum refining and related industries	2,043	2.2
12	69	Wholesale and retail trade	1,584	1.7
13	27	Chemicals and selected chemical products	1,071	1.2
14	51	Office, computing, and accounting machine	867	0.9
15	68	Private electric, gas, water, and sanitar	862	0.9
16	77	Health, educational, and social services	764	0.8
17	43	Engines and turbines	725	0.8
18	62	Scientific and controlling instruments	708	0.8
19	59	Motor vehicles and equipment	685	0.7
20	40	Heating, plumbing, and fabricated structu	634	0.7

Sources: The Russian Input-Output Table for 1987 and the U.S. Use Table for 1977.

As can be seen in Tables 2 and 3, in the United States the "government industry" shows the highest share in both 'material' outputs and final demand for defense; 6% in the total gross domestic output and 46% in the total final demand for defense.The "aircraft and parts" sector shows the second highest share in the total final demand for defense, 10%, followed by "ordnance and accessories", "radio, TV, and communication equipment", "noncomparable imports" and "other transportation equipment". The "radio, TV and communication equipment" sector shows slightly high share in the total gross domestic output.

From the above observation, Russia and the United States have remarkable similarities in terms of defense-related output and demand structures although there are also many differences between the two countries. The Russian "other machine industry", which should not be considered as 'other', may include the aircraft industry as one of the major sources while the American "government industry" (a fictitious sector) does not include the aircraft industry but includes many secret sources of military expenditures. In this context, we can not claim only the secrecy and classification regarding to "other machine industry." Demand for "new construction" in the United States of Table 3 shows rather high share while that in Russia does not appear in Table 3. This is due to the traditional convention of MPS I-O; therein all the construction activities are classified into fixed capital formation (investment). (The depreciation of the column "other expenditures" is displayed under the final demand quadrant of the Russian I-O.) Unlike the U.S. case, the items of final demand for defense in the Russian I-O ("other expenditures") do not fully cover the final demand for defense. This results in an underestimate of defense expenditures for Russia. Indeed, the total sum of military expenditures specified in I-O constitutes only 3% of GDP in 1990 in Russia, while it amounts to 5% of total net final demand in 1977 in the United States.

Needless to say, the Russian I-O is based on domestic prices, regardless of purchasers' and producers' prices. Russian domestic prices has been far from their world prices while domestic prices in the United States reflect their world price levels. If we evaluate the elements of Russian I-O in terms of world prices, the shares of oil-related sectors and defense-related sectors in the total domestic output would show a marked increase. However, even then the above observation on defense expenditures may be essentially true. Further, this would be retained in terms of producers' prices and SNA although it needs more detailed analysis.

Let us next compare the Russian and U.S. input-output structures by employing the Rasmussen Coefficients, based on the B1-type Leontief inverse matrix. Tables 4 and 5 present the ten highest and lowest sectors of power of dispersion in Russia and the United States. Tables 6 and 7 show the ten highest and lowest sectors of sensitivity of dispersion in these two countries. From these tables we can state that there are similarities between Russia and U.S. technology structures, even though there are many differences in the methods used for compiling the databases.

In both countries the power coefficients of dispersion for the sectors supplying textiles and meat are very high. In other words these sectors draw heavily on the system of industries in both countries. On the other hand, the sensitivity coefficients of dispersion for the producing of basic metals, food, electricity and transport services are also very high. These sectors only seem to influence the system of industries to a relatively small extent. It should also be noted that unlike the Treml's Soviet input-output table, the Russian input-output table makes distinction between ferrous and non-ferrous metals.

It can also be seen that in both countries the power coefficients of dispersion for the

TABLE 4. POWER OF DISPERSION: THE TEN HIGHEST SECTORS

1987 Russia (Purchasers' Prices)

Rank	Sector Goskomstat 111-Order Code		
1.	92	Dairy products	2.261
2.	91	Meat products	2.152
3.	74	Flax materials	1.622
4.	75	Wool materials	1.528
5.	73	Cotton materials	1.383
6.	81	Sugar	1.348
7.	88	Fruit & vegetable products	1.323
8.	82	Bread and bakery products	1.266
9.	96	Processed animal feeds	1.244
10.	33	Cable products	1.242

1972 U.S. (Producers' Prices)

Rank	Sector BEA's 85-Order Code		
1.	33	Leather tanning and finishing	1.354
2.	1	Livestock and livestock products	1.347
3.	14	Food and kindred products	1.307
4.	17	Miscellaneous textile goods and floor coverings	1.287
5.	38	Primary nonferrous metals manufacturing	1.260
6.	18	Apparel	1.254
7.	19	Miscellaneous fabricated textile products	1.252
8.	16	Broad and narrow fabrics, yarn and thread mils	1.238
9.	39	Metal containers	1.190
10.	59	Motor vehicles and equipments	1.189

sectors supplying petroleum, natural gas and distribution services are remarkably low. It appears that the system of industry as a whole draws heavily on these sectors.

On the other hand, the sensitivity coefficient of dispersion for the construction sector is the lowest in each country. This sector is therefore only slightly affected by a general increase in final demand.

In regard to the distribution of the Rasmussen coefficient we can see that in both Russia and the United States industries producing basic metals, meat, textiles and plastics are placed in Category I (high power and sensitivity of dispersion). An important exception is seen in use of the Russian I-O: "radio and electronics", "electric M & E (machine and equipment)" and "other machine industry" show a rather high coefficient of sensitivity of dispersion (1.18, 1.20 and 1.55 respectively). On the other hand, the "radio and electronics", "Electric M & E" and "other machine industry" sectors for Russia show rather low coefficients of power of dispersion (0.95, 0.96 and 0.96 respectively). Thus these sectors are placed in Category I. We can assume, therefore, that the "radio and electronics", "Electric M & E" and "other machine" sectors are rather drawn upon by the Russian system of industries as a whole and at the same these sectors draw rather on the Russian system of industries as a whole. In the U.S. case all industries belonging to the MBMW (machine-building and metal-working) sector are placed

TABLE 5. POWER OF DISPERSION: THE TEN LOWEST SECTORS
1987 Russia (Purchasers' Prices)

Rank	Sector Goskomstat 111-Order Code		
1.	109	Technical supply	0.511
2.	106	Communications	0.517
3.	86	Alcoholic beverages	0.530
4.	110	Information processing	0.547
5.	108	Procurement	0.598
6.	107	Trade & restaurants	0.599
7.	105	Transportation	0.670
8.	2	Crude oil	0.679
9.	104	Forestry	0.733
10.	72	Glass and porcelain	0.764

1972 U.S. (Producers' Prices)

Rank	Sector BEA's 85-Order Code		
1.	66	Communications except radio and TV	0.631
2.	71	Real estate and rental	0.645
3.	69	Wholesale and retail trade	0.684
4.	67	Radio TV broadcasting	0.713
5.	78	Federal Government enterprises	0.724
6.	8	Crude petroleum and natural gas	0.758
7.	77	Health educ., & social serv. and nonprofit org.	0.771
8.	73	Business services	0.792
9.	65	Transportations and warehousing	0.837
10.	70	Finance and insurance	0.852

in either Category III or IV. Namely, the U.S. MBMW industries show rather low coefficients of sensitivity of dispersion and thus are only slightly affected by a general increase in final demand.

III. *Concluding Remarks*

Even though our analysis based on the Russmussen coefficients suggests strange characteristics of many of the Russian MBMW sectors, some of which are directly related with defense activities, it should be noted that our impact analysis clearly shows the marked importance of the MBMW sector for the Russian economy. Namely, impact analysis based on the Russian 18 sector I-O in producers' prices in 1989 suggests that the MBMW sector shows a remarkably high value of inducement coefficient, followed by construction, food industry and light industry [Kuboniwa (1993)] . This implies that the core of the Russian economy has been the machine industry, half of which relates to military demand. Thus, reduction of final demand for this industry, including exports, and delay of military conversion will be highly damaging to the Russian domestic production system. The Russian economic difficulties for

TABLE 6. SENSITIVITY OF DISPERSION: THE TEN HIGHEST SECTORS

1987 Russia (Purchasers' Prices)

Rank	Sector Goskomstat 111-Order Code		
1.	105	Transportation	7.574
2.	9	Iron and steel	3.619
3.	102	Crops	3.533
4.	1	Electric and thermal power	3.201
5.	103	Livestock	3.030
6.	14	Nonferrous metals	2.933
7.	3	Oil refining	2.843
8.	107	Trade & restaurants	2.777
9.	73	Cotton materials	2.727
10.	4	Gas	2.042

1972 U.S. (Producers' Prices)

Rank	Sector BEA's 85-Order Code		
1.	37	Primary iron and steel manufacturing	3.220
2.	73	Business services	2.965
3.	69	Wholesale and retail trade	2.821
4.	65	Transportation and warehousing	2.658
5.	71	Real estate and rental	2.492
6.	38	Primary nonferrous metals manufacturing	2.470
7.	27	Chemicals and selected chemical products	2.344
8.	68	Electric, gas, water, sanitary services	2.135
9.	20	Lumber and wood products, except containers	1.570
10.	14	Food and kindred products	1.659

the years 1992–1994 can be explained partly by these analyses even though the official output statistics shows a marked downward bias and in some fields a cushion effect by a rapid substitution from military to civilian goods is seen.

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TABLE 7. SENSITIVITY OF DISPERSION: THE TEN LOWEST SECTORS

1987 Russia (Purchasers' Prices)

Rank	Sector Goskomstat 111-Order Code		
1.	101	Construction	0.469
2.	82	Bread and bakery products	0.476
3.	37	Casting equipment	0.479
4.	99	Medical supplies	0.482
5.	65	Asbestos-cement and slate	0.483
6.	66	Roofing materials	0.483
7.	36	Forging-pressing equipment	0.486
8.	98	Medical equipment	0.486
9.	47	Food industry M&E	0.490
10.	50	Household appliances	0.491

1972 U.S. (Producers' Prices)

Rank	Sector BEA's 85-Order Code		
1.	11	New construction	0.492
2.	67	Radio and TV broadcasting	0.492
3.	23	Other furniture and fixtures	0.508
4.	13	Ordnance and accessories	0.514
5.	22	Household furniture	0.514
6.	34	Footwear and other leather products	0.516
7.	79	State and local government enterprises	0.523
8.	21	Wood containers	0.523
9.	54	Household appliances	0.526
10.	44	Farm and garden machinery	0.543

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